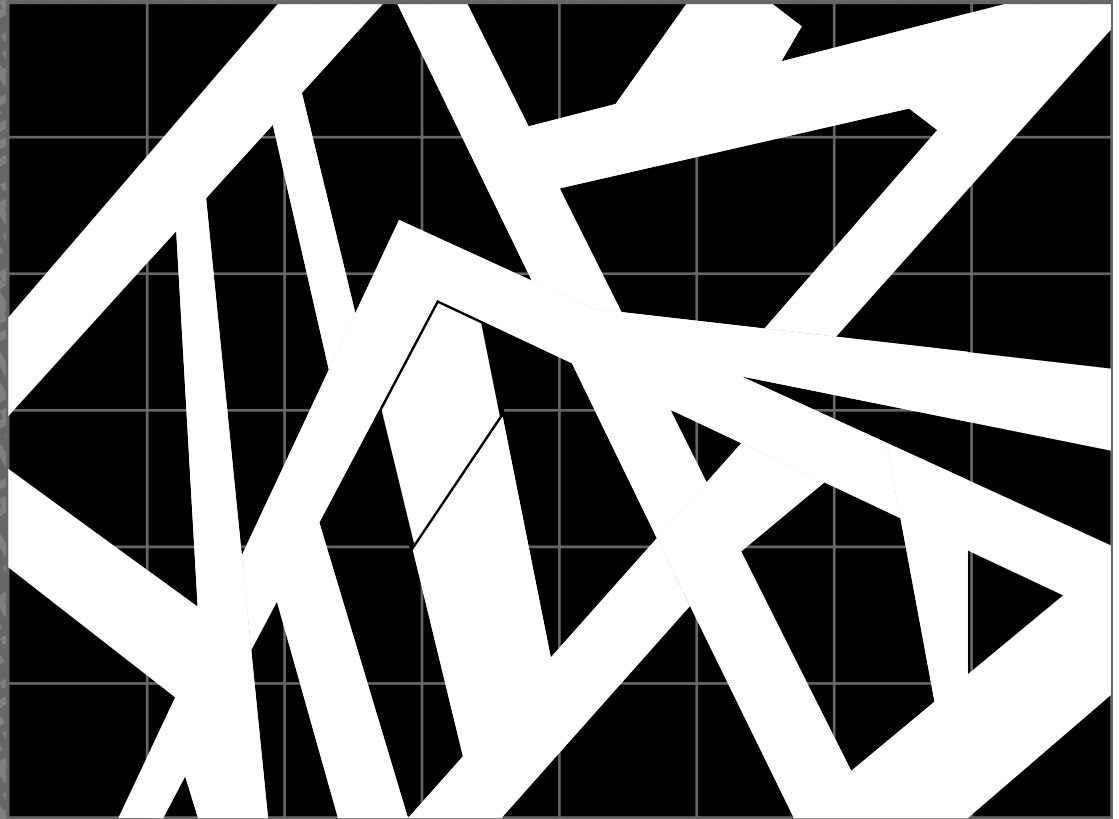www.teachinteract.com

ALGEBRA
MYSTERY MAZE

Solving Algebra Chains within a Maze Competition

Hours of Instruction: 15+

Grades: 5–9

Overview: Students compete in teams to solve algebra problems quickly and accurately, and to design mazes that challenge their classmates.

Your students will:
- Solve algebraic equations and simple algebra word problems
- Develop confidence to work algebra problems quickly and accurately
- Apply skills of measurement to navigate and design mazes
- Apply math communication skills to describe problem-solving strategies
- Work cooperatively as they rotate through the roles of Measurer, Designer, and Recorder

Visit our website @ www.teachinteract.com for FREE Sample Activities and to see a complete list of our titles!

Answer Key
For student activities with specific objective responses, this icon directs you to the answer key.

Learning Tip
Found in the Student Guide. This directs your students to important procedures or directions.

Teaching Tip
In the margins of your Teacher Guide, these tips clarify materials or procedures.

Read or Tell
This is important information your students need for the activity. Be sure to read the passage or clearly instruct your students as stated in your Teacher Guide.

Grouping
This shows if your students work independently, in partners or in cooperative groups for each activity.

Timing
Many activities vary in length. Use this icon to help plan your teaching time.

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NATE CATTELL graduated from Pennsylvania State University with a BA in graphic design. He later earned his Pennsylvania Elementary Teaching Certification and has taught sixth grade in the State College Area School District for 31 years. In 1991, Nate was the Pennsylvania recipient of a Presidential Award for Excellence in Mathematics Teaching. He delights in creating new challenge activities for his students. For Interact Nate also authored CHALLENGE MATH PROJECTS (2000) and GEOMETRY CHALLENGE (2002).

The nationwide movement for high standards has not only determined what students should learn, but also has mandated that students <u>demonstrate</u> what they know. ALGEBRA MYSTERY MAZE is a standards-based program addressing National Math Standards and provides many opportunities for performance assessments. Students apply their math skills and creativity to solve algebraic equations, algebra word problems, and mazes. The cooperation, peer teaching, and group decision-making address Applied Learning Standards.

National Standards for School Mathematics

Computation and Estimation Standard
- Using computing and estimating to solve problems

Algebra Standard
- Developing an initial conceptual understanding of different uses of variables
- Using symbolic algebra to represent situations and to solve problems
- Recognizing and generating equivalent forms of simple algebraic expressions

Measurement Standard
- Apply appropriate techniques, tools, and formulas to determine measurements
- Understand measurable attributes of objects and units, systems, and processes of measurement

Problem Solving
- Build new knowledge through problem solving
- Apply and adapt a variety of appropriate strategies to solve problems

Communication Standard
- Organize and consolidate their thinking through communication
- Communicate their math thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

California Applied Learning Standards

Standard 6. Students will understand how to apply communication skills and techniques. Students will demonstrate ability to communicate orally and in writing.

Standard 8. Students will understand the importance of teamwork. Students will work on teams to achieve project objectives.

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Extensions

Most students need a lot of practice to solve algebra problems confidently. ALGEBRA MYSTERY MAZE offers a way for students to gain that confidence in the exciting setting of friendly competition. You may tailor the difficulty and length of the ALGEBRA MYSTERY MAZE experience to your individual classes. The Teacher Guide and Student Guides provide instruction and samples to teach necessary math skills. You may supplement the instruction provided as dictated by the needs of your students. You may also substitute your own choice of algebra problems for some or all of the competitions.

Every activity in ALGEBRA MYSTERY MAZE encourages students to use higher-level thinking skills. Knowledge, application, analysis, evaluation, and synthesis are all needed to work through the various phases of this experience. Through their work in ALGEBRA MYSTERY MAZE your students will understand and experience the following:

Knowledge
- Understand that letters represent numbers in equations
- Understand meaning and application of *order of operations*
- Understand meaning of *equation, variable, transformations, and reciprocals*

Skills
- Apply algebra skills to solve algebraic equations
- Apply algebra skills to solve algebra word problems
- Apply learned concepts to new problems
- Solve a problem in a variety of ways
- Work cooperatively with other students to develop problem-solving strategies
- Apply visualization, measurement, and estimation to construct a maze

Attitudes
- Enjoy increased confidence to solve algebraic equations quickly
- Enjoy increased confidence to develop different approaches to problem solving
- Appreciate the use of algebra to solve real-life word problems
- Appreciate the value of collaborative working relationships
- Demonstrate the willingness to take risks based on knowledge, estimation, math concepts, and visualization

ALGEBRA MYSTERY MAZE is an exciting unit that causes students to develop and review algebra skills while they design and solve mazes. The mazes require teamwork and decision making as students use their previous experiences to help them shape new decisions. Effort, skill, wise decision-making, and a little luck are necessary to amass the most centimeter lengths by the end of the unit.

In teams of three, students apply their algebra skills to solve algebraic equations and simple algebra word problems. These problems form chains—sets of math tasks requiring that they use the answer from one problem to solve for a new unknown in the next problem. The points they earn in the Algebra Chain activities translate into centimeter (cm) lengths. The teams use the cms earned and apply other math skills (measurement and math communication) to navigate mystery mazes. Students work cooperatively as they rotate through the roles of Measurer, Designer, and Recorder. After completing all the chain activities and mazes, the members of each team compete by designing individual mazes to challenge their classmates. *Marble Maze Challenge* is the exciting culmination of the unit. Each team designs a 3-dimensional maze with baffles and turns within a covered box. They challenge others to roll a marble from a starting hole to an exit hole in the shortest possible time.

Differentiation Opportunities

ALGEBRA MYSTERY MAZE incorporates Howard Gardner's Multiple Intelligences:

- **Visual-spatial** — drawing and creating verbal/physical imagery
- **Bodily-Kinesthetic** — hands on experiences
- **Interpersonal** — interacting and planning with others
- **Intrapersonal** — reflecting on solutions, generating personal creative solutions
- **Linguistic** — using words effectively in communicating orally and when writing evaluations (reflections)
- **Logical-Mathematical** — reasoning, calculating, thinking conceptually, and abstractly, and seeing and exploring number relationships

Special Needs Students

Like all Interact units, ALGEBRA MYSTERY MAZE provides differentiated instruction through its various learning opportunities. Students learn and experience the knowledge, skills, and attitudes through all domains of language (reading, writing, speaking, and listening) and math (counting, tallying, computing, etc.). Adjust the level of difficulty to best fit the needs of your students. Allow students to use calculators. Assist special needs students in the activities to utilize their strengths and to succeed. Work together with the Resource Specialist teacher, Gifted and Talented teacher, or other specialist to coordinate instruction.

ALGEBRA MYSTERY MAZE makes extensive use of Algebra Chains to teach and reinforce algebra skills. An algebra chain is a competitive device that will enliven your regular class work and gather assessments at the same time. The idea is simple: your students compete in teams to solve algebra equations or algebra word problems.

1. **What is an Algebra Chain?**
    a. An Algebra Chain is a set of math tasks distributed simultaneously to all students.
    b. Student teams work as quickly as they can to complete each new problem correctly.
        • Students solve each equation independently, then consult team members to check their accuracy.
        • Any difference in results flags an error on the part of one team member.
    c. They use the correct answer from one problem as the value for the unknown in the next equation.
    d. Teams amass centimeter lengths (hereafter called cms) for the number of problems they solve correctly, and by the order they finish in the class (first, second, third, etc.)
        • Each Algebra Chain has a multiplier value for awarding cms for correct responses.
        • Cms earned indicate success in both solving Algebra Chain problems and using other math skills (measurement, computation, and math communication).

2. **How Does an Algebra Chain Work?**
    a. To begin, you will state the value of the first unknown and direct students to write it in the top box.

    > Sample from page 8 of the Student Guide.
    > Value of first unknown $(z = 4)$
    >   1. $[(z \times 3) \div (4 \div 2)] = a$ $(a = 6)$
    >   2. $(6 \times 6) \div (15 - a) = b$ $(b = 4)$
    >   3. $[(30 \times 10) + b] \div 4 = c$ $(c = 76)$
    >   4. $[(c + 4) \div (72 \div 9)] = d$ $(d = 10)$

    b. Each Algebra Chain has a corresponding **Key** for your use. To verify that teams are generating correct answers, move around to all teams with **Key** in hand.
    c. Check <u>only</u> the Recorder's work. If you find a mistake, it is a team mistake. Indicate the last correct answer and give a hint for solving the problem (if necessary).

TEACHING TIP

Review the teaching pages for each chain thoroughly to enable your students to solve the equations or problems.

TEACHING TIP

Use the correct answer from one problem as the value for the unknown in the next equation.

All students on the team work the problems independently and check their accuracy with each other. Because students write answers in boxes, checking the papers while walking from team to team is easy.

ABOUT THE UNIT

   d. Circle only the ***first*** problem in a string of errors that is incorrect. Students must rework the incorrect problem and all following equations based on that answer.

   e. Obviously it is essential that you keep moving from team to team while checking so that a team does not work a whole chain using an incorrect answer.

   f. Encourage students to work as quickly and as accurately as they can. Teams that finish first or second have an advantage over teams that finish later.

   g. Teams earn centimeter lengths (cms) for each problem they solve correctly, and additional cms depending on what order they finish in the class (first, second, third, etc.)

   h. To determine the total cms earned, multiply the number of correct problems by the multiplier for that chain.
(7 correct x multiplier n = 7n cms)

3. **Algebra Chains and Mazes**
   Student teams spend the cms they earn during the Algebra Chain competitions to navigate mazes.
      a. They select a starting point while studying only a partial maze, and navigate to <u>any</u> end mark on the complete maze.
      b. Following strict navigation and measurement rules, they attempt to navigate the maze by using the least number of cms possible.

4. **Algebra Chains and Competition**
   The competition in ALGEBRA MYSTERY MAZE is supposed to be friendly. The timed Algebra Chains are meant to add excitement to the routine of practice.
      a. Depending on the skill level of your students, the competitions may become lopsided. No one wants to win a competition if the opponents are not worthy competitors.
      b. Use the **Extensions** (teaching directions begin on page 51) to enable students to earn additional cms and level the playing field. This will sharpen team spirit and enhance team competition during the final maze competitions.
      c. At the end, many students will recognize that luck plays a role in ALGEBRA MYSTERY MAZE.

1. **Before you Begin**
   Read this entire Teacher Guide and the Student Guide. Decide how you will use ALGEBRA MYSTERY MAZE in your math curriculum. Modify the procedures outlined for ALGEBRA MYSTERY MAZE to best fit your teaching preferences and your students' needs.
   a. Study the Algebra Chain activities.
   b. Familiarize yourself with the various mazes.
   c. Use the **Daily Directions** to lead your students through the steps for successful friendly competition through the Algebra Chains and mazes.
   d. Determine how you will stage the *Marble Maze Challenge*.
   e. Use **Extension** activities to supplement your regular curriculum or keep the competition more even.

2. **Using the Teacher Guide**
   Throughout the Teacher Guide Interact employs certain editorial conventions to identify materials.
   a. In preparing materials, *class set* means *one per student*.
   b. One *Day* on the **Unit Time Chart** is the length of a normal *class period*—45 minutes to one hour.
   c. All transparency masters and student handouts are listed by name using ALL CAPITAL LETTERS.
   d. Teacher reference pages are named in **Bold**.
   e. Special events are named using *Italics* (e.g., the *Individual Maze Competition*).
   f. In lieu of points students earn centimeter lengths (cms).

3. **Using the Student Guide**
   The Student Guide introduces students to ALGEBRA MYSTERY MAZE. It also includes teaching pages with examples. Use the Student Guide to teach individual concepts:
   • Order of operations (page 2)
   • Substitution of a numerical value for a variable (page 3)
   • Transformations involving addition and subtraction (page 4)
   • Transformations involving multiplication and division (page 5)
   • Using reciprocals to solve algebraic equations containing fractions and decimals (page 6)

SETUP DIRECTIONS

4. **Planning your Schedule**
   The daily lesson plans describe 15 days of lessons. This is only a recommendation.
   a. Adjust the timeline to accommodate your own teaching objectives and the needs and capabilities of your students.
   b. If your students are familiar with solving algebra equations, you can abbreviate these lessons.
   c. See **Adapting Algebra Mystery Maze** (page 15) for more information about the unit and alternative schedules.

5. **Grouping Students**
   Arrange your class into heterogeneous groups of three students. Each day they work as a team; there are three roles: **Recorder**, **Measurer**, and **Designer**.
   a. Each role has a primary responsibility for the day, but all members of the team must help one another to get the jobs done successfully and on time. The roles rotate with every new Algebra Chain.
   b. Use the COOPERATIVE GROUP WORK RUBRIC as often as necessary to reinforce good behavior and to give concrete feedback to students who are not working cooperatively.

6. **Preparing your Classroom**
   a. Create a bulletin board to display samples of mazes. Use the Internet to find pictures to download. See **Setup Directions #12**, **Using the Internet** (page 9) for more information.
   b. You may also designate an area on the bulletin board to record team cms.
   c. Students need a work area large enough to work Algebra Chain problems, hold discussions, and construct mazes. Three student desks arranged side by side is usually adequate. The **Recorder** always sits in the middle desk on Algebra Chain days. The **Measurer** always sits in the middle desk on Maze days.
   d. At the end of each day, insist that teams collect all their materials and store them safely in a designated area. If the materials are too bulky for the team folders, have students put all work in large paper bags marked with team names.
   e. Consider making a large poster of the COOPERATIVE GROUP WORK RUBRIC to hang at the front of the class.

7. **Teacher Reference Pages**
   This unit includes answer keys for all regular unit activities and **Extensions**.
   • **Pretest/Posttest Key**
   • **Algebra Chains 1–6 Keys**
   • **Individual Assessment Chains 1–6 Keys**
   • **Additional Problems Maze #4 Key**
   • **Order of Operations Challenge Key**
   • **Writing Algebra Equations Key**
   • **Word Problem Chains A, B, and C Keys**

You will use most of these keys during instruction as students work.

8. **Duplication Materials**
   • COOPERATIVE GROUP WORK RUBRIC — *as needed + one to post (optional)*
   • TALLY — *two per team or as needed (you may need more for **Extension** activities)*
   • PRETEST/POSTTEST — *two class sets*
   • ALGEBRA CHAIN 1 — *class set*
   • PARTIAL MAZE #1 — *one per team*
   • MAZE #1 — *one per team*
   • ALGEBRA CHAIN 2 — *class set*
   • INDIVIDUAL ASSESSMENT CHAINS 1 & 2 — *class set*
   • PARTIAL MAZE #2 — *one per team*
   • MAZE #2 — *one per team*
   • PEER AUDIT REPORT — *three per team*
   • ALGEBRA CHAIN 3 — *class set*
   • PARTIAL MAZE #3 — *one per team*
   • MAZE #3 — *one per team*
   • ALGEBRA CHAIN 4 — *class set*
   • INDIVIDUAL ASSESSMENT CHAINS 3 & 4 — *class set*
   • PARTIAL MAZE #4 — *one per team*
   • MAZE #4 — *one per team*
   • ADDITIONAL PROBLEMS MAZE #4 — *class set*
   • ALGEBRA CHAIN 5 — *class set*
   • INDIVIDUAL ASSESSMENT CHAINS 5 & 6 — *class set*
   • DESIGNING INDIVIDUAL MAZES — *class set*
   • INDIVIDUAL MAZE TEMPLATE — *class set*
   • MAZE DESIGN RUBRIC (4 on a page) — *class set*
   • MARBLE MAZE PATTERN — *one per team*
   • PATTERN FOR BAFFLES — *one per team*
   • MARBLE MAZE TIME RECORD — *one per team*

Consider making transparencies of duplication materials or Student Guide pages as visual aids to supplement instruction.

Extensions
- ORDER OF OPERATIONS CHALLENGE — *as needed*
- WRITING ALGEBRA EQUATIONS — *as needed*
- ALGEBRA CHAIN 6 — *class set*
- MAZE #5 — *one per team + transparency*
- WORD PROBLEM CHAIN A — *as needed*
- WORD PROBLEM CHAIN B — *as needed*
- WORD PROBLEM CHAIN C — *as needed*
- PROBLEM-SOLVING FORMAT SAMPLE — *as needed*
- PROBLEM-SOLVING FORMAT — *as needed*
- PROBLEM-SOLVING RUBRIC (2 on a page) — *class set or as needed*

9. **Other Materials**
   - Additional problems for more practice — *as necessary*
   - Brown paper shopping bags — *one per team (optional)*
   - Calculators — *one or more per team (optional)*
   - Centimeter graph paper — *six sheets per team (optional)*
   - Centimeter rulers — *class set*
   - Colored pencils — *class set*
   - Dark Crayons — *one per team*
   - Die — *one*
   - Felt pens, crayons, or markers — *one set per team*
   - Manila drawing paper (12" x 18") — *class set (optional; for mounting individual mazes)*
   - Manila file folders — *one per DUPLICATION page (optional)*
   - Marbles — *one per team*
   - Oaktag (or heavy-weight paper, 12" x 18") — *two per team*
   - Pocket folders or large brown envelopes — *one per team*
   - Scissors — *one per team*
   - Scrap paper — *24 sheets per team*
   - Transparent tape — *one roll per team*
   - Watch/clock with sweep second hand or stop watch — *one per team*

10. **Organizing Materials**
    a. You may choose to duplicate all the materials needed for the unit before starting the unit, or duplicate as you go along. It is a good idea to store each set in its own manila file folder.
    b. Store the duplication sets in the order that they are used. (See **Daily Directions** or **Unit Time Chart**.) If a set is used more than once like the PRETEST/POSTTEST, you may make two separate manila file folders, or just move the folder to its new position after you have used it the first time.

c. The number to be duplicated is a minimum. Make a few extras in case some are lost or must be redone.

d. Be sure to return the originals to the Teacher Guide.

11. **Organizing Team Folders**

a. Each team will need a pocket folder or large envelope in which to store its daily work, activity sheets, etc. The **Recorder** is responsible for the team folder at the end of the day. If there are more materials than the folder can hold, place them in a large brown paper grocery bag, label, and store in a safe place in your classroom.

b. Staple two copies of the TALLY and one COOPERATIVE GROUP RUBRIC onto every team folder.

c. Put one Student Guide into each folder for each team member.

12. **Using the Internet**

If you have access to the Internet, your students may benefit by looking on the web for information on algebra or mazes.

a. Before using the Internet, become familiar with your school's Acceptable Use Policy. Always preview any website you make available to your students. If your students do not have classroom access to the Internet, you may access the Internet and build a notebook of information printed off the various websites you locate.

b. **Interact's Internet Resource List**. Several recommended website addresses are listed on a Resource page available through the Interact web page. To find the **ALGEBRA MYSTERY MAZE** Resource Page, complete the following steps:

- Connect to the Internet
- Go to Interact's site at: **www.teachinteract.com**
- Click the "**Resources**" button
- Click the "**ALGEBRA MYSTERY MAZE**" link
- Click any links of interest
- Click the "**Back**" button to return to Interact's home page

c. Advise your students that they may find both reliable and unreliable information on the Internet. Suggest that they check source information carefully.